SCREENING APPARATUS

FIELD OF THE INVENTION

[0001] The present invention relates to a screening apparatus for separating fiber suspensions, preferably pulp suspensions. More particularly, the present invention relates to screening apparatus comprising a screen housing and centrally enclosed therein a stator, which is surrounded by a screen means co-axial with the stator and rotary about a rotor shaft. The screen means divides the interior of the screen housing into a screen chamber between the screen housing, and screen means and an accept chamber between the screen means and stator. The screening apparatus further comprises an inlet for the pulp suspension to the screen chamber, a reject outlet for reject from the screen chamber and an accept outlet for accept from the accept chamber.

BACKGROUND OF THE INVENTION

[0002] Screening apparatus of the type referred to above is used during the coarse and fine screening of pulp suspensions, preferably for fractionating or separating impurities which are not desired to be included in the final product, such as shives, coarse particles, scrap, stones or undigested or unrefined chip bits. The screening apparatus is usually pressurized.

[0003] The pulp suspension to be screened is generally introduced through the inlet to the screen chamber where the approved fraction, *i.e.*, the accept, flows through the rotating screen means. The accept is thereafter discharged through the accept outlet. In order to create suction pulses, pulse elements are provided on the stator. The pulse elements are designed as wings extending in the axial direction along the entire stator and screen means. The wings are arranged in a manner such that the pulp suspension can pass between the wings and stator.

[0004] The portion of the pulp suspension which does not pass through the screen means (*i.e.*, the reject), is

discharged through a reject outlet, which is usually located as a radial outlet at the lower portion of the screen housing.

[0005] A well-known problem in this connection such as during the screening of papermaking pulp, is that the pulp suspension in the screen chamber, relatively close to the reject outlet, assumes a pulp concentration higher than that of the pulp suspension relatively close to the inlet. This is due to the fact that during screening, the liquid in the pulp suspension is transported to and through the screen means at a higher speed than the fibers in the pulp suspension. Thus, a dewatering of the pulp suspension is obtained, which results in the suspension increasingly being thickened the closer to the reject outlet it arrives. Thereby a thickened reject layer is obtained at the screen means near the reject outlet. The thickening increases still more during a relatively low flow rate in the reject outlet, *i.e.*, at low reject discharge. During heavy thickening a problem arises, namely at the moment of transfer between screen housing and screen means at the thickened pulp suspension. This has a braking effect on the screen means, which causes increased energy consumption for rotating the screen means, and which may even result in stopping the screen means entirely. The thickening can also cause plugging and thus problems with removing the reject through the reject outlet. It is presently desired to be able to screen pulp suspensions with as high a pulp concentration as possible. The thickening, thus, becomes a great problem, because the pulp suspension during its introduction to the screen chamber already has a high concentration.

[0006] One object of the present invention is to provide an apparatus which to a great extent reduces or eliminates the above-noted problems with thickening.

SUMMARY OF THE INVENTION

[0007] In accordance with the present invention, this and other objects have now been realized by the invention of appartus for separating a fiber suspension comprising a housing, a stator mounted centrally within the housing, a

rotary screen rotatably mounted between the housing and the stator thereby dividing the housing into a screen chamber between the housing and the rotary screen and an accept chamber between the rotary screen and the stator, an inlet for providing the fiber suspension to the screen chamber, a reject outlet for withdrawing rejected fiber suspension from the screen chamber, and an accept outlet for withdrawing accepted fiber suspension from the accept chamber, the stator including at least one barrier member fixedly attached to the stator and extending axially along the length of the stator, the at least one barrier member extending radially from the stator to the rotary screen whereby the accepted fiber suspension is substantially prevented from tangentially passing the at least one barrier member and the at least one barrier member creates a pulse through the rotary screen. Preferably, the fiber suspension comprises a pulp suspension.

[0008] In accordance with one embodiment of the apparatus of the present invention, the at least one barrier member includes a pulse surface facing the rotary screen, the pulse surface having a shape such that the distance between the pulse surface and the rotary screen decreases in the direction of rotation of the rotary screen.

[0009] In accordance with another embodiment of the apparatus of the present invention, the at least one barrier member extends outwardly from the stator in an axial direction towards the accept outlet and faces in a direction towards the direction of rotation of the rotary screen.

[00010] In accordance with another embodiment of the apparatus of the present invention, the at least one barrier member extends radially outwardly from the stator at a predetermined angle. Preferably, the predetermined angle is perpendicular or comprises an angle facing the direction of rotation of the rotary screen.

[00011] In accordance with another embodiment of the apparatus of the present invention, the stator, the rotary screen and the housing each has the shape of a cylinder.

[00012] In accordance with yet another embodiment of the apparatus of the present invention, the rotary screen has the shape of a cone, with an increase in diameter in the direction facing towards the accept outlet.

[00013] In accordance with another embodiment of the apparatus of the present invention, the at least one barrier member comprises from 2 to 8 barrier members, and preferably from 3 to 4 barrier members.

[00014] In accordance with yet another embodiment of the apparatus of the present invention, the minimum distance between the at least one barrier member and the rotary screen is from 4 to 10 mm.

[00015] In accordance with another embodiment of the apparatus of the invention, the at least one barrier member comprises the outer surface of the stator.

[00016] In accordance with the present invention, apparatus is provided for separating a fiber suspension through a rotary screen rotatably mounted within a housing, the apparatus comprising a stator mountable centrally within the housing and the rotary screen, the stator including at least one barrier member fixedly attached to the stator and extending axially along the length of the stator.

[00017] The objects of the present invention are achieved by a screen apparatus which comprises at least one barrier and pulse element (barrier/pulse element). The barrier/pulse element is located on the stator and extends in the axial direction substantially along the entire stator and the entire screen means, and is capable upon rotation of the screen means of creating both suction pulses and pressure pulses with respect to the pulp suspension in the screen chamber. The pressure pulses produce a substantially radially directed pump effect to the screen means and outwardly in the pulp suspension in the screen chamber, so that the reject continuously and directly after the beginning of the screen passes through the reject outlet. Consequently, substantially no thickened reject layer is built up, and the risk of

plugging is reduced considerably. It is therefore possible to screen at higher pulp concentrations without disturbances.

[00018] The barrier/pulse element, as contrasted with the pulse elements of the prior art, is attached tightly to the stator and extends from the stator outwardly to the screen means, so that the accept is substantially prevented from tangentially passing the barrier/pulse element. The accept is thereby forced either to move axially to the accept outlet or, due to the pressure pulse, radially to the screen means, whereby the screen means is cleaned, and the pulp suspension in the screen chamber is mixed with that accept portion, which passes out through the screen means.

[00019] In addition to the aforementioned advantages, such a screen has proved to yield a uniform quality of the accept, even when the injected suspension has a non-uniform quality with regard to the content of, for example, shives, coarse particles, knots, incompletely digested or unrefined chip bits.

BRIEF DESCRIPTION OF THE DRAWINGS

[00020] The present invention is described in greater detail in the following detailed description, which, in turn, refers to the accompanying drawings illustrating one embodiment of the present invention, as follows:

[00021] Fig. 1 is a side, elevational, partially sectional view of a screening apparatus according to the present invention;

[00022] Fig. 2 is a top, elevational, partially sectional view of the screening apparatus shown in Fig. 1;

[00023] Fig. 3 is a top, elevational, enlarged, sectional view of the barrier/pulse element shown in Fig. 2;

[00024] Fig. 4 is a top, elevational, enlarged, sectional view of another design of the barrier/pulse element shown in Fig. 3;

[00025] Fig. 5 is a top, elevational, enlarged, sectional view of another design of the barrier/pulse element shown in Fig. 3; and

[00026] Fig. 6 is a top, elevational, enlarged, sectional view of another design of the barrier/pulse element shown in Fig. 3.

DETAILED DESCRIPTION

[00027] The screening apparatus shown in Fig. I comprises a pressurized screen housing I with an upper portion 2, which has a greater diameter than the lower portion 3 of the screen housing. In the upper portion 2 of the screen housing I a substantially tangential inlet 4 is located for the fiber suspension to be separated, which in this example is a pulp

[00028] suspension. An accept outlet 5 for the accept is located substantially tangentially in the lower portion 3 of the screen housing I. A reject outlet 6 is located substantially axially and downwardly directed in the lower side of the upper portion 2, but radially outside the lower portion 3.

[00029] In the upper portion 2 of the screen housing a rotationally symmetrical screen means 7 is located so that it is rotary about a vertical rotor shaft 11. A stator 8 is located radially inside the screen means 7. The screen means 7 and stator 8 are arranged co-axially. The screen means 7 defines the upper portion 2 of the screen housing I in a screen chamber 9 between the screen housing I and screen means 7 and an accept chamber 10 between the screen means 7 and stator 8.

[00030] The screen means 7 can be any type of screen means comprising screen apertures of a suitable size for passing through the desired portion of the pulp suspension. The screen means, for example, can have slits with openings between 0.1 mm and 0.5 mm, or holes with hole diameters between 0.1 mm and 12 mm, and during coarse screening, preferably from 8 to 10 mm.

[00031] In the lower portion 3 of the screen housing a lower accept chamber 13 is located which constitutes an extension of the accept chamber 10.

[00032] On the stator 8 four barrier/pulse elements 12 are located symmetrically. The barrier/pulse elements 12 can be one or more in number, but are suitably from 2 to 8 and most preferably from 3 to 4, and are advantageously arranged symmetrically in the circumferential direction of the stator 8.

[00033] The barrier/pulse elements 12 extend in the axial direction along the entire stator and are attached tightly to the stator 8. They extend from the stator 8 and out to and along the entire screen means 7. The distance between the barrier/pulse elements 12 and screen means 7 shall be so small that the accept (accepted suspension) substantially does not pass there between. A suitable minimum distance between the barrier/pulse element 12 and screen means 7 is from 4 to 10 mm. The accept chamber 10 is thereby divided into a number of smaller accept cells 10_1, 10_2, 10_3 and 10_4, each of which communicates with the lower accept chamber 13 in the lower portion 3 of the screen housing and thereby with the accept outlet 5.

[00034] In the embodiment shown in the drawings, the barrier/pulse elements 12 extend in the axial direction straight downwardly from above. In order to assist in feeding the accept in the accept 10_1, 10_2, 10_3 and 10_4 to the accept outlet 5, the barrier/pulse elements 12 can instead be designed so that, as axially seen in the direction to the accept outlet 5 (in this example downward from above) they deflect in the rotational direction of the screen means. In this manner, the accept is guided more easily to the accept outlet 5, and a lower pressure drop above the stator 8 is obtained.

[00035] The pulp suspension to be separated is fed through the inlet 4 into the screen chamber 9. The rotating screen means 7 mechanically transfers energy to the pulp suspension in the screen chamber 9, which thereby follows the rotational direction of the screen means at the same time as it moves downwardly and thereby in a screwing movement moves down

through the screen chamber 9. When the screen means rotates, a suction pulse arises on the rear side of the barrier/pulse element 12, as seen in the rotational direction. The accepted fraction of the pulp suspension thereby flows through the rotating screen means 7 and into one of the accept cells, 10_1, 10_2, 10_3 or 10_4. The main portion of the accept thereafter flows down to the lower accept chamber 13 and out through the accept outlet 5.

[00036] During the rotation of the screen means 7, the accept in the accept cells, 10_1, 10_2, 10_3 and 10_4, partially follows along in the rotation of the screen means 7. When the accept approaches the barrier/pulse element 12, portions of the accept are pressed back out through the screen means 7 and out into the screen chamber 9. In this manner, the screen means 7 is cleaned of possible clogging, and the pulp suspension in the screen chamber 9 is mixed with the accept fraction from the accept chamber 10. Thus, too heavy a thickening of the pulp suspension in the screen chamber 9 is prevented, and at the same time rotation of the accept in the same direction in the accept chamber 10 is prevented.

[00037] The portion of the pulp suspension in the screen chamber 9 which cannot pass through the screen means 7, continues to move in a screwing movement down through the screen chamber 9 and out through the reject outlet 6.

[00038] The barrier/pulse element 12, in order to produce strong pressure pulses to the pulp suspension in the screen chamber 9 upon rotation of the screen means 7, is suitably designed as shown in Fig. 3. Facing toward the screen means 7, the barrier/pulse element 12 has a pulse surface 14, where the distance between the pulse surface 14 and screen means 7 decreases in the rotational direction of the screen means, to the point where the barrier/pulse element 12 is located closest to the screen means 7. When the accept approaches the barrier/pulse element 12, it is thus forced, by the shape of the barrier/pulse element 12, out through the screen means 7 and out into the screen chamber 9.

[00039] In Fig. 4 the same design of the barrier/pulse element as in Fig. 3 is shown, but in this case the barrier/pulse element is not attached to the stator 8, but is formed as a single unit with the stator 8, which, of course, is also possible.

[00040] Fig. 5 shows a different embodiment of the barrier/pulse element 12, which has a smaller pulse surface 14 than the barrier/pulse element in Fig. 3. This barrier/pulse element 12, thus, does not produce equally strong pressure pulses. Fig. 6 shows another different embodiment of the barrier/pulse element 12, which is designed as a curved metal sheet. The barrier/pulse element, of course, can also be designed in other ways.

[00041] The portion of the barrier/pulse element 12 which faces the rotational direction of the screen means 7, should be designed so that it assists in guiding the accept out to the screen means 7. This surface should, as seen radially from the inside of the stator 8 and out to the screen means, be radial as in Fig. 5 or deflected in the rotational direction of the screen means 7, as in Fig. 6.

[00042] In the embodiment shown in the drawings, the stator 8, screen means 7 and screen housing I outside the screen means 7 all have the form of a cylinder. One or more of the stator, screen means and screen housing outside the screen means can also, for example, have a conical shape, with different or equal angular relations relative to one another. By forming the screen housing outside the stator, and forming the stator cylindrical or conical, it is possible to alter the accessible space between them. By changing, for example, the screen means from cylindrical to conical in shape, the relationship between accessible space in the screen chamber and the accept chamber, respectively, can be altered. If accessible space in axial direction thus becomes different, the space in the accept chamber should increase in the direction to the accept outlet, and the space in the screen chamber should be greatest at the inlet.

[00043] The accept outlet, reject outlet and inlet can also be located in places in the screening apparatus other than those indicated in the embodiment shown in the drawings. The accept outlet, for example, can be located in the upper portion of the screening apparatus, and the inlet an be located in the lower portion thereof. The reject outlet is suitably located in the lower portion of the screening apparatus, in order to utilize the gravity at the separation of heavy foreign particles.

[00044] In one variant of the stator, in addition to barrier/pulse elements it can also be provided with pulse elements of a conventional type. It can, for example, be provided with 4 barrier/pulse elements and between them with conventional pulse elements, where the accept can pass between the wing and the stator.

[00045] A screening apparatus according to the present invention can also be used separately as well as in combination with other screens in a common screen housing.

[00046] Although the invention herein has been described with reference to particular embodiments, it is to be understood that these embodiments are merely illustrative of the principles and applications of the present invention. It is therefore to be understood that numerous modifications may be made to the illustrative embodiments and that other arrangements may be devised without departing from the spirit and scope of the present invention as defined by the appended claims.

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